

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the chemical filter for air pure using the ionic exchanger which came to be suddenly used for a clean room in precision electronic industry and drugs manufactures, such as semiconductor industry, recently.

[0002]

[Description of the Prior Art] As a chemical filter from which the gas constituents in the air are removed, the activated carbon particle, the activated carbon fiber, and the filter that installed acid and alkali to them are known. The filter which supported an oxide and metal to other carriers is also known. Since not only the extraction ratio of the gas constituents of a ppb level is high, but the chemical filter using an ionic exchanger did not have re-discharge of the adsorbate, it began to be used in the semiconductor related industry especially in recent years.

[0003] As shape of an ionic exchanger of using for a chemical filter, an extraction ratio is high, and is lightweight, and what the molding process used as an easy nonwoven fabric and textile fabrics is often used. As for the ion exchange group, anion exchange groups, such as cation exchange groups, such as sulfonic acid and a carboxyl group, a quaternary ammonium group, and the third class amino group, etc. are used. Except for the inert gas of a hydrocarbon system, it dissolves in water and many of gas constituents in the air show acidity and alkalinity. It is mainly thought that the removal mechanism of the gas constituents in the air by an ion exchange group is the neutralization reaction in which water participated like the case where it is used underwater. That is, acid gas, such as a sulfur oxide, serves as an anion, anion exchange textiles are adsorbed, and basic gas, such as ammonia, serves as a cation and is adsorbed by cation exchange textiles.

[0004] Therefore, in the operating environment of a chemical filter, sufficient water, i.e., humidity, is required. If there is this [no], improvement in sufficient extraction ratio and an exchange capacity capacity factor cannot be expected, but usually needs to manage relative humidity to not less than 50%. Until now, the wet scrubber was provided in the open air introduction line to the clean room, there was an example which carries out washing removal of gas constituents and the particles under open air, and there was a case where the air which has sufficient humidity for the chemical filter installed in the lower stream was flowing. However, this example was not what the air of high humidity only flowed into the chemical filter by chance, and meant the improved efficiency of the chemical filter. It appears also in management of the water used for a wet scrubber not being enough, either, for example. When tap water with high salt concentration is used, the droplet flows into a chemical filter, ion exchange capacity is consumed uneconomically, or it collects, and microorganisms, such as mold, grow up to the condensing part of water or a steam, it enters into a chemical filter and the problem of pressure loss going up is pointed out.

[0005]

[Problem(s) to be Solved by the Invention] This invention makes it a technical problem to provide the chemical filter which management of humidity is eased, can raise processing efficiency, and can prevent propagation of the microorganism of processing environment effectively by lowering the relative humidity of the environment which can use a chemical filter.

[0006]

[Means for Solving the Problem] This invention is a chemical filter possessing a means to control environment which uses ionic exchanger chemical filter material and this ionic exchanger chemical filter material which contain an ionic exchanger at least to not less than 20% of relative humidity. It finds out that processing efficiency of this invention of ionic exchanger chemical filter material will improve extremely if relative humidity of processing environment by a chemical filter is controlled to not less than 20%.

[0007] That is, if relative humidity is not not less than 20%, adsorption capacity of this filter material will be small, and an exchange capacity capacity factor will become small. or [necessity / in space / almost / management of relative humidity / hardly since it is controlled by space which a numerical value of 20% of relative humidity is a quite small value, and was managed like a chip fabrication factory to not less than 20%] -- or it is very easy. Although a case where the open air is adopted in a winter season, special space in a factory, etc. pose a problem, compared with the former, management of relative humidity is easy also in this case.

[0008] A publicly known cation exchanger and an anion exchanger can be conventionally used for an ionic exchanger used for this invention. ionic exchanger chemical filter material -- at least one sort in a cation exchanger and an anion exchanger -- it can be independent, or it can combine and can use. What has the conventionally publicly known ion exchange group of each ionic exchanger itself is used, for example, a quaternary ammonium group, the third class amino group, etc. are mentioned as anion exchange groups, such as sulfonic acid and a carboxyl group, as a cation exchange group.

[0009] In this invention, an ion exchange group is connected with carrier resin so that space where especially the desirable ionic exchanger can adsorb a water molecule enough around an ion exchange group may be formed. As carrier resin, a graft copolymer is preferred and a graft copolymer of trunk polymer, such as polyolefines, such as polyethylene and polypropylene, and branch polymer, such as polymethacrylic acid glycidyl (GMA), polyacrylic acid, and polystyrene, is mentioned. Polyacrylic acid polymerizes a monomer which has an ion exchange group, and GMA and styrene are the monomers which can introduce an ion exchange group after graft polymerization. Thing of branch polymer with a functional group which can react to sulfite salt, such as a glycidyl group, and can form sulfonic acid which is an ion exchange group is preferred. What sulfonated styrene with concentrated sulfuric acid etc. is preferred. As for such a graft copolymer, what is manufactured by a radiation graft polymerization method is specifically preferred.

[0010] As radiation used for a radiation graft polymerization method, an electron beam and a gamma ray are preferred and the dose can be suitably set up according to a kind of trunk polymer. Although comonomer and a graft polymerization reaction which serve as branch polymer by a publicly known method are presented with trunk polymer processed by radiation, trunk polymer by which radiation irradiation was carried out preferably being immersed in a comonomer solution, and making it react is mentioned. Conditions of this graft polymerization reaction, for example, temperature, a kind of solvent in a solution of comonomer, concentration of comonomer, reaction time, etc. are selected suitably. Although a graft rate may be suitably set up by selecting said reaction condition, it is usually 20 to 250% of range.

[0011] The reaction which forms an ion exchange group in an obtained copolymer can use a publicly known method suitably conventionally. An ion exchange group is hanging down from a motile good graft chain in the shape of a pendant dramatically, and an ionic exchanger using a radiation graft polymerization method is adsorbing sufficient water molecule for the surroundings of an ion exchange

group. Therefore, a minimum of relative humidity can fully demonstrate performance also at low relative humidity of 20%. However, since the conventional ionic exchanger has the structure of cross linkage, it cannot usually adsorb sufficient water molecule for the surroundings of an ion exchange group. Therefore, in order to demonstrate performance, relative humidity had to be managed to not less than about 50%.

[0012]Therefore, since the ionic exchanger used for this invention can make relative humidity lower than before, its measure top against sterilization is also advantageous. by the way, a case where it humidifies even when using which ionic exchanger -- water -- humidification -- service water -- it is used, putting into a tub. It discharges, after leading the water of condensation to water receiving tanks, such as a drain pan, when dehumidifying. such -- it collects and a microorganism grows up easily in water. Especially water containing salts, such as tap water, has many nutritive salts etc., and becomes a hotbed of a microorganism easily. If a droplet containing salts adhere to a chemical filter, ion exchange capacity will be consumed.

[0013]In order to control relative humidity of treatment space, if pure water is used, such a problem will improve considerably, but it is not perfect. Here, as for pure water, electric conductivity points out the following [5microS]. Therefore, it is more desirable to sterilize independently. UV irradiation is suitable, although there are many methods in a sterilizing method and all can be applied. Not only a bactericidal effect but hydrocarbon etc. which are the inert gas in the air are for ***** at an ingredient which oxidizes by UV irradiation and tends to be removed by chemical filters, such as organic acid. Change for an ingredient which is easy to remove also about inorganic gas, such as nitrogen oxides, is expectable. Although an object of UV irradiation does not have restriction in particular, a various device containing a chemical filter arranged the circumference of the above-mentioned water and in the treatment space by a chemical filter of this invention itself or this space are mentioned.

[0014]If the surface of a wetted part of water in a humidifier and space is processed with an antimicrobial agent, a bactericidal effect will be demonstrated further. Shape of an ionic exchanger to textile fabrics and a nonwoven fabric, and a pan which are aggregates of a staple fiber and a staple fiber, and those processed goods The fabricating-operation article. (For example, a filter), etc. powder and particles, those processed goods. (for example, resin), etc. films, and a hollow fiber -- since material with many openings, such as what was chosen from opening nature materials, such as processed goods (for example, hollow fiber module etc.) of them and foam, or processed goods (for example, sponge etc.) of those, tends to do control of humidity and a radiation graft polymerization method can be applied, it is desirable. Textile fabrics and a nonwoven fabric which is an aggregate of textiles are lightweight especially, and it is small, and pressure loss is easy also for a molding process, and preferred.

[0015]The ionic exchanger chemical filter material used for this invention can use a publicly known filter material together with the above-mentioned ionic exchanger. As a filter material which can be used together, what supported an oxide and metal is conventionally mentioned to a publicly known thing which was described above, for example, an activated carbon particle, an activated carbon fiber or a thing that installed acid and alkali to them, other carriers, for example, zeolite, alumina, activated carbon, etc. What have shape [be / the same as that of the above-mentioned ionic exchanger / it] of these filter materials is mentioned, and there is no restriction in particular.

[0016]A using rate of the above-mentioned ionic exchanger and a publicly known filter material takes into consideration a size and processing efficiency of relative humidity, and may be adjusted suitably. A chemical filter of this invention comprises at least a filter part and the above relative-humidity-control

means of having ionic exchanger chemical filter material. A relative-humidity-control means comprises a control device which usually connected them with a humidifier and a relative humidity meter containing pure water. A filter part holds a filter member and a filter member, and it usually comprises at least a suction means of a pump for making a filter material penetrate a frame and air which pass processing air, etc. And this filter member has the maintaining structure fixed to a means and a frame which support ionic exchanger chemical filter material, such as a frame member, and, as for this frame member, it is preferred to make plurality into structure which can be connected with multistage. Said control device can be constituted so that a suction means of a pump of a chemical filter, etc. may be connected with and turning on and off of a pump and air capacity may be controlled according to a kind of relative humidity and filter material, etc.

[0017] Publicly known methods, such as an electrode type, an ultrasonic system, and a high voltage spray type, can be used for a humidifier. A humidifier and a relative humidity meter may be arranged outside also inside a frame of a filter part, or whichever may be sufficient as them.

[0018]

[Example] Hereafter, although the concrete example of this invention is described, this invention is not limited to this.

The 100kGy exposure of the electron beam (1MeV, 1 mA) was carried out for with manufacture eyes 50 g/m² of a highly acidic cation exchange fiber nonwoven fabric, the thick taste of 0.4 mm, and a fiber diameter of about 20 micrometers product nonwoven fabric made from polyethylene 2m² by a nitrogen atmosphere. Subsequently, this nonwoven fabric was immersed in the glycidyl methacrylate solution, the graft polymerization reaction was performed, and 148% of the graft rate was acquired. It sulfonated in sodium sulfite solution, and when it dried after reproduction with chloride, the highly acidic cation exchange nonwoven fabric of salt-splitting-capacity 2.81 meq/g was made.

The circulation test highly acidic cation exchange nonwoven fabric of ammonia was cut to 5 cm**, relative humidity was changed using the gas stream Tooru test equipment shown in drawing 1, and the circulation test of ammonia was done. Equip a sample applied part with this nonwoven fabric, and ammonia, Pass permeator with dry air, and on the other hand, change relative humidity to 0 to 80% with the humidifier implement, the flow instrument, pump, and control device (un-illustrating) into which pure water was put, and it mixes the air of said relative humidity with ammonia, Aging of the ammonia concentration of what extracted the gas which went via the thing which extracted this mixed gas from the gas sampling line entrance, and the sample from the gas sampling line exit is measured, It asked for the relative humidity in the 10% breakthrough time in the highly acidic cation exchange nonwoven fabric of a sample, and the relation of ion-exchange-capacity consumption. It asked at the 10% breakthrough time from (100x outlet concentration / entrance concentration =10). A result is as in Table 1 and the adsorption performance of ammonia was comparatively stable in not less than 20% of relative humidity. In less than 20% of relative humidity, adsorption capacity decreased sharply. The ammonia concentration in a gas sampling line entrance was about 10 ppm.

[0019]

[Table 1]

相対湿度とイオン交換容量消費率の関係

相対湿度(%)	イオン交換容量消費率(%)
0	1. 0
10	21. 7
15	39. 2
20	60. 0
30	60. 0
50	62. 5
80	68. 5

[0020]

[Effect of the Invention]By this invention, the removal performance of the gas constituents of ionic exchanger chemical filter material was stable, and improvement in an extraction ratio and an ionic exchange amount of consumption was attained. Relative humidity management of processing environment was eased and it not only also solved the problem by microorganism propagation of processing environment, but it was able to raise the extraction ratio of the inert gas of a hydrocarbon system.

[Translation done.]